Collaborative Visualization Tools for the Analysis of Petascale Combustion Simulation Data

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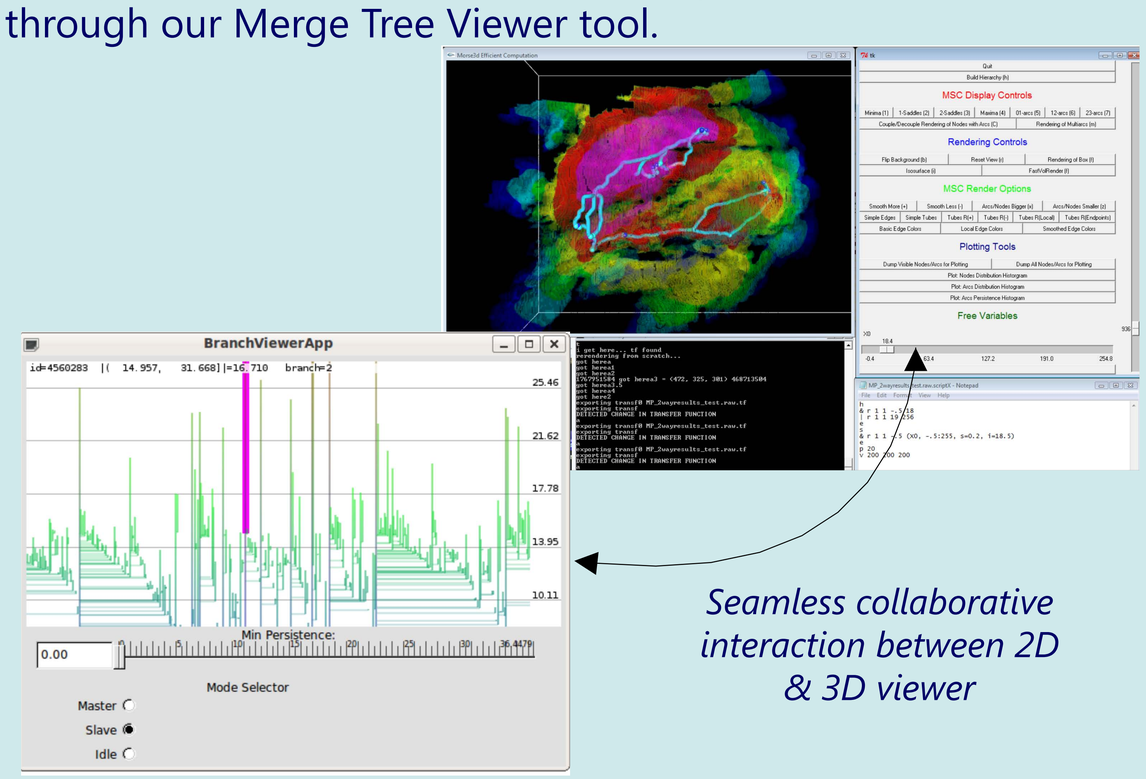
Our current work involves creating a visualization toolkit for scientists at the Combustion Research Facility (CRF) at Sandia National Laboratories. Scientists at the CRF are conducting research towards the design of future fuel-efficient combustors utilizing alternative fuels by running simulations on petascale computers that generate hundreds of terabytes of data.

Our aim is to provide them with a visualization toolkit that enables a scientist to study the data generated by these simulations from multiple perspectives in a collaborative environment.

Collaboration

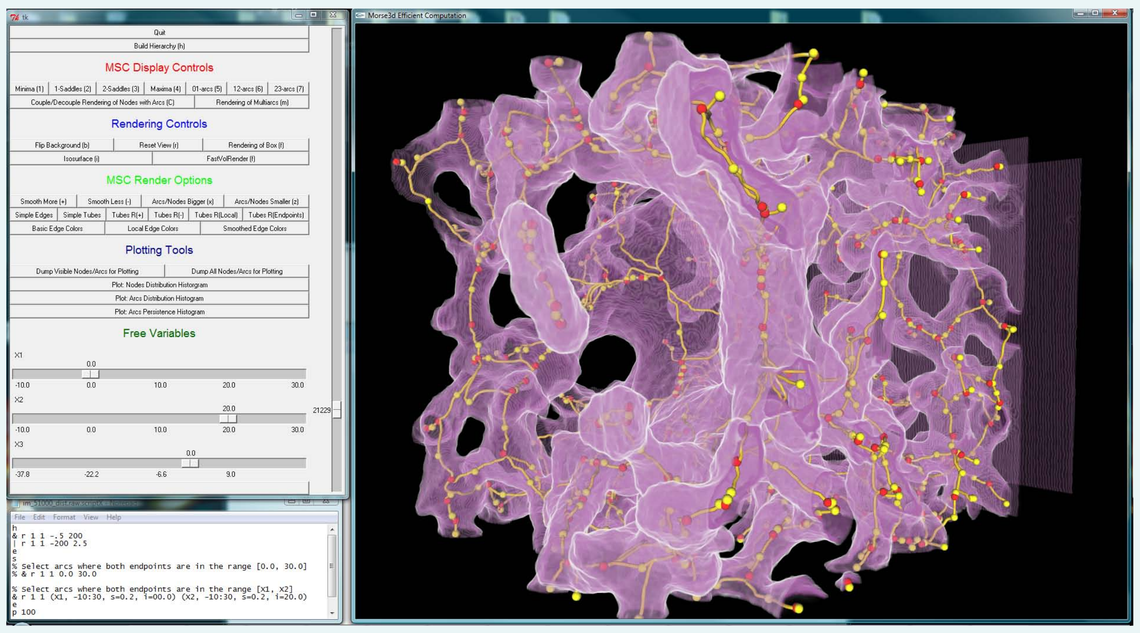
Our system aims to allow transparent interactions by users at multiple remote locations. Currently this is demonstrated through our Merge Tree Viewer tool.



Seamless collaborative interaction between 2D & 3D viewer

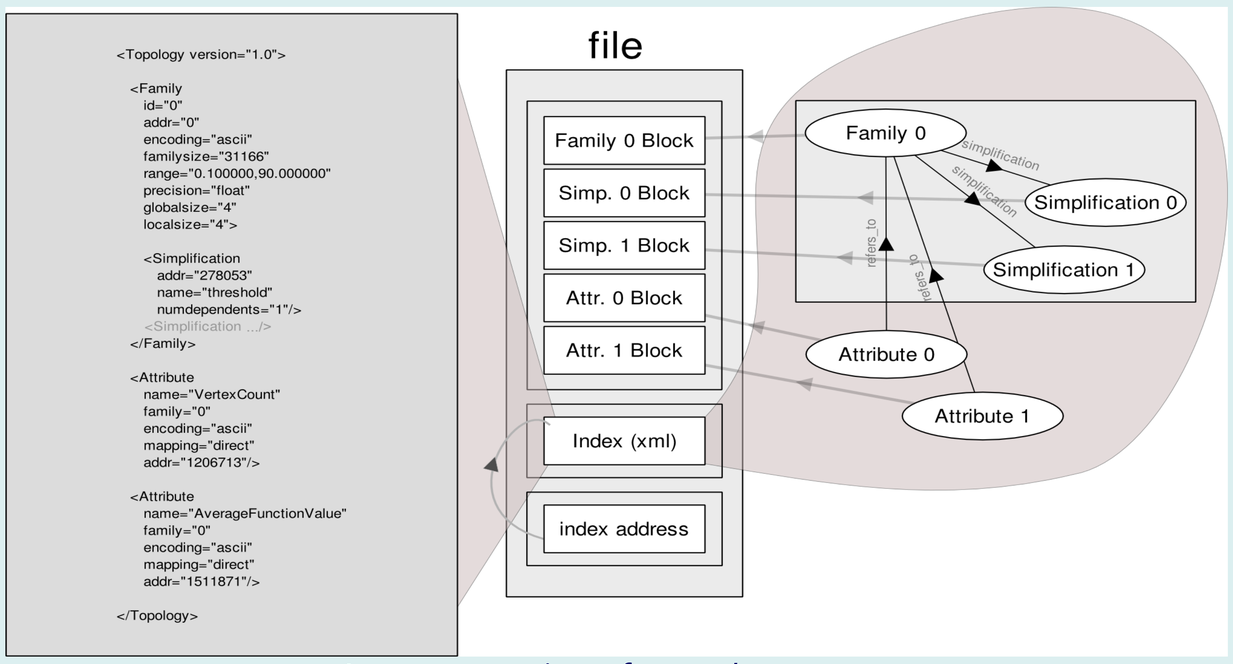
Visualization

Our system will allow a user to interactively study a dataset through 2 primary techniques. A 3D tool will provide the user with a higher level picture of the simulation. The user can interactively select regions of interest or features from the 3 dimensional visualization and study them using the time tracking feature of our graphing tool.



A framework for the storage of Topological Hierarchies

One of the first issues we have tackled is that of designing a framework for the storage of the data generated by these huge simulations.



A representation of our schema

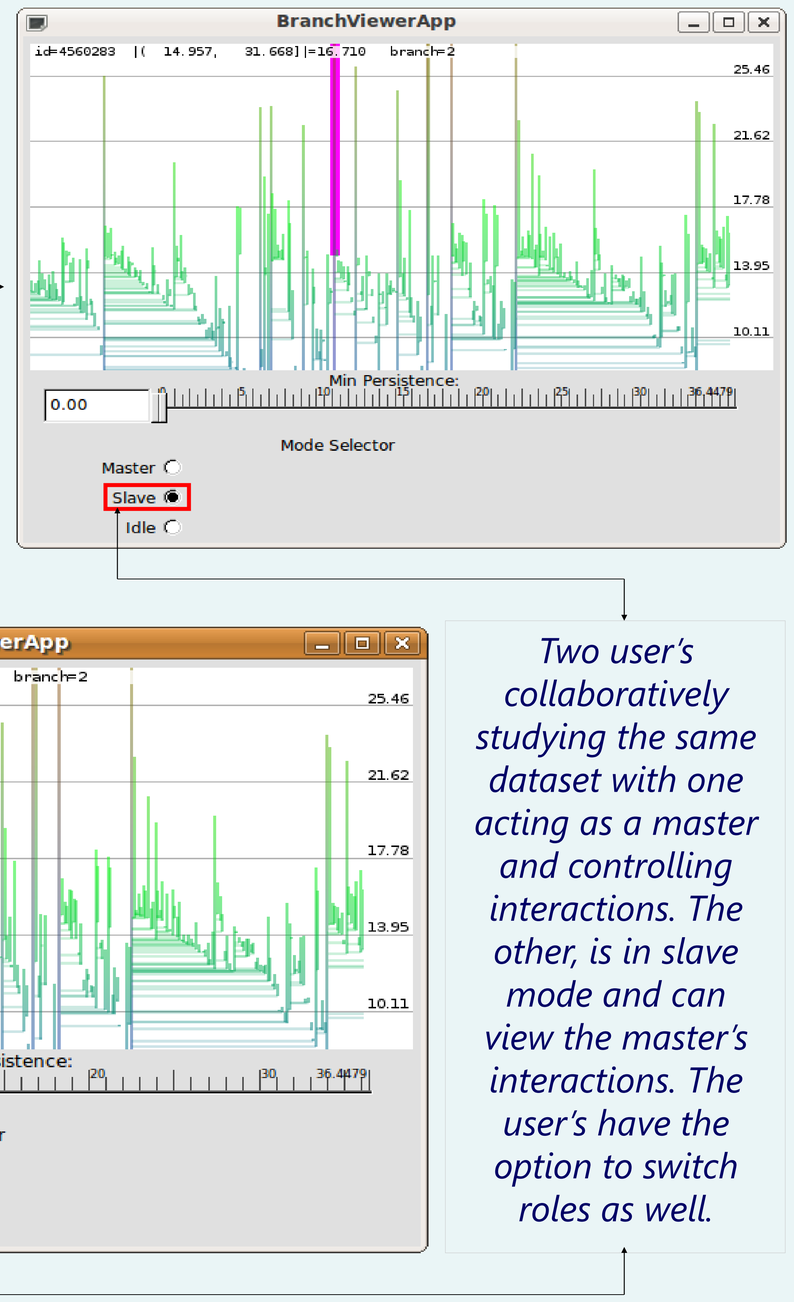
The simulations generate time varying multi variate data on a structured 3 dimensional grid that represents the combustion zone. A simple 500 cubed grid can thus have gigabytes worth of data from a simulation that ran for just a few seconds. Brute force techniques simply don't work given the scale of the data being generated. In this context, topological hierarchies are important summaries of what happens in these simulations.

We define a schema that is flexible enough to handle multiple topological hierarchies and different statistics associated with the features in these hierarchies.

Morse-Smale Complex Viewer

Currently, we have implemented a collaborative Merge Tree viewer which will form a part of the 2D graph viewing tool. We are using this to test and fine-tune the collaborative feature of our toolkit.

Synchronized Merge Tree Branch Viewer



Two user's collaboratively studying the same dataset with one acting as a master and controlling interactions. The other, is in slave mode and can view the master's interactions. The user's have the option to switch roles as well.